PART III

Physical Description

Physical Regions of Washington

On the basis of surface features, Washington may be divided into eight general regions. Agricultural settlement is influenced by factors of topography, climate, soil, forest vegetation and water resources distinctive to each of the physiographic regions. Each has become a different type of farming area as settlers have learned to adapt crops and livestock to the conditions, or have improved limitations through drainage or irrigation.

Coastal Plains

A narrow, sandy plain with shallow bays, tidal flats, stream deltas and low headlands lies between the coastline and the Coast Range. It extends from the Columbia River mouth almost to Cape Flattery, being widest and lowest in the Grays Harbor and Willapa Bay districts. The climate is mild and damp with a long growing season, but it is too cool, cloudy and wet for most crops. Originally this area was covered with heavy forests and much is now covered with woodlands. Lumbering and manufacture of wood products is the main industry. Farming is largely of the livestock and dairying type on low uplands and drained areas in the lower Chehalis River Valley. Cranberry growing is important and well-adapted to numerous, boggy areas in the Grays Harbor and Willapa Bay sections. The shallow bays are also used for oyster culture. Fishing is common in the rivers and coastal banks.

Coast Range

The Coast Range is an uplifted area of sedimentary and metamorphic rocks divided into the Olympic Mountains and the Willapa Hills. The Olympics tower to nearly 8,000 feet in a dome-like structure, carved deeply by rivers. These mountains have the heaviest precipitation in the state. Snowfields and heavy forest cover the mountains. Most of the wilderness area is within the Olympic National Forest and Olympic National Park, being managed for recreation, wildlife and timber. Farm settlement is limited to some foothill river plains and coastal terraces such as the Dungeness and Port Angeles districts along the Strait of Juan De Fuca. Here in the lee of the mountains, rainfall is moderate and irrigation is practiced by some livestock farmers. The Willapa Hills country is wet, heavily forested and carved into numerous narrow valleys. Logging is the main industry, combined with livestock farming in the upper Chehalis River Valley and along the banks of the Columbia River. Wet climate, hilly topography and the difficulty of clearing stump land retards agriculture.

Willamette-Puget Sound Lowland

A broad lowland, described as a trough or valley, lies between the Coast Range and the Cascade Mountains. The northern part is the Puget Sound Lowland which has been glaciated and occupied by the sea in the lowest section. The continental glacier reached slightly south of Olympia. Under a warming climate it melted and geologists believe it receded about 25,000 years ago, leaving an infertile plain of moraines and outwash gravels, sands and clays known today

as the Puget Glacial Drift Plain. Its rolling surface has numerous lakes and bogs. Most of the major cities--Seattle, Tacoma, Everett, Bellingham and Olympia--have been built on moraines bordering the Sound. Rivers, such as the Nooksack, Skagit, Snoqualmie, White and Puyallup, built up deltas and flood plains over the older gravelly plains. These narrow valleys are more fertile than the older glacial plains and support numerous small dairy, vegetable and berry farms. Most of the gravelly areas are wooded with a second-growth forest and are used for pastures. In the southern part of the Willamette-Puget Sound Lowland, there are two large valleys--the Cowlitz and Chehalis. They drain a low, hilly area with several flat prairies and bottom lands.

Agriculture is handicapped by poor drainage and flooding of the river deltas and plains, by heavy winter rainfall, by cloudy but dry summers, by coarse, gravelly upland soils and by densely wooded land which is costly to clear. Advantages are mild climate and a location close to major markets for farm products such as milk, poultry and vegetables.

Cascade Mountains

The Cascades are a wide and high topographic and climatic barrier which separates western and eastern Washington. The range is made up of sedimentary, igneous and metamorphic rocks which have been carved by glaciers and streams. High, isolated volcanic cones of lava such as Mt. Adams (12,307 feet), Mt. Rainier (14,408 feet) and Mt. Baker (10,791 feet) appear upon the older Cascade rocks. The Cascade crest varies between 3,000 and 10,000 feet and is higher and more rugged in northern Washington. Roads and railroads have been built across its lower passes in central and southern Washington. The Columbia River has cut a deep gorge and the lowest pass through the barrier. The western slope is wet and heavily forested with Douglas fir. The eastern slope is drier with a less-dense pine forest. Nearly all classified as forest land, most of the area is in Federal ownership in five national forests and Mount Rainier National Park. Tree fruit farming in the eastern slope valleys of Wenatchee, Chelan, Methow, Naches and the Columbia Gorge is most important. Sheep and cattle summer grazing on alpine grasslands is another use. Deep western slope valley bottoms such as the Skagit, Snoqualmie, Nisqually, Cowlitz and Lewis also contain livestock farms. The area is vitally important as a source of timber. Steep terrain, wet climate, short growing seasons and heavy forest vegetation are main handicaps for agriculture.

Columbia Basin

A low plateau of old lava rocks covered with stream and wind-deposited soils extends in a series of plains, ridges, coulees and hills from the Cascades to the eastern Washington border. The area is basin-like in structure, being higher around its margins and sloping inward to low and level central plains. It has been sharply eroded by the Columbia River and its interior tributaries, the Snake, Yakima, Palouse and Spokane Rivers. The basin has sub-areas created by crustal movements and erosion.

The Yakima Folds are a series of hilly ridges extending from the Cascades eastward into the lower part of the basin. The Yakima and Columbia Rivers have cut gaps through the ridges and built up plains in the troughs between them. The rich, alluvial plain of the Yakima River is an important irrigated valley.

The Waterville Plateau is a tableland of thin soils overlaying basaltic rock at an elevation of 2,500 to 3,000 feet. It has gorges cut by the Columbia River and ancient glacial outwash streams once flowing in Moses and Grand Coulees. It is too high for irrigation and is used for dryland grain and livestock farming. The high plain is often called the Big Bend country.

The Channelled Scablands is a belt of dry terrain carved by ice-age rivers into a series of coulees. Bare rock is exposed in the coulees. Small plateaus between the old river channels have thin soils used for dryland farming. The Grand Coulee of this region has been developed into a major irrigation reservoir.

The Palouse Hills consist of fertile deposits of wind-blown soil overlaying basaltic lava flows. After being deposited in large dunes, the formation was reshaped by streams into an intricate pattern of low, rounded hills which are tilled for wheat, barley and legumes. The hills receive 16 to 25 inches of rainfall and have deep, porous and fertile soils. It is one of the richest farming areas of the Pacific Northwest.

The Central Plains are low and relatively level expanses of soil, deposited by old streams crossing the Channelled Scablands and later by the flooding of the Yakima, Columbia, Snake and Walla Walla Rivers. Climate is desert-like (6-12 inches of precipitation per year). The lower lands of the area, the Quincy and Pasco Basins and the Walla Walla Valley, are irrigated. Quincy Basin is a new irrigation area watered by Grand Coulee Dam.

Agricultural handicaps in Columbia Basin regions are mainly found in its dry, continental climate. Large irrigation systems built since 1900 have overcome much of the need for water on rich valley and basin soils. Dryland farming in higher areas is practiced widely, although occasional variations in rainfall, lack of snowfall, winter-kill, water and wind erosion inflict damage to field crops and to livestock ranges.

Okanogan Highlands

A portion of the Rocky Mountains, consisting of well-eroded old granites, lavas and sedimentary rocks, extends across north central Washington. These are the Okanogan Highlands, the state's richest mineral area. Summit levels reach 4,000 to 5,000 feet with peaks exceeding 7,000 feet. Prominent north-south valleys are occupied by irrigated tree fruit and livestock farms. These are the Okanogan, Sanpoil, Kettle and Colville Valleys. The Columbia River gorge through the Okanogan Highlands is occupied by the large man-made lake behind Grand Coulee Dam--Roosevelt Lake. High and wetter portions are forested with pine and larch, and are managed for timber and for livestock ranges by the United States Forest Service and the Bureau of Indian Affairs. Cold winter temperatures, short growing seasons, dry valley climates and distance from markets are farming handicaps.

Selkirk Mountains

The Selkirks, a range of the Rocky Mountain system, extend into the northeast corner of Washington. The rocks are old mineralized granites and metamorphics reaching elevations of over 7,000 feet. The Pend Oreille River Valley

at the base of the Selkirks is an agricultural area of narrow bottom lands settled by livestock farmers. Nearly all of the uplands are in Kaniksu National Forest. While climate is cool and growing seasons are short, the Pend Oreille Valley has an advantage of being closely located to the Spokane metropolitan market area.

Blue Mountains

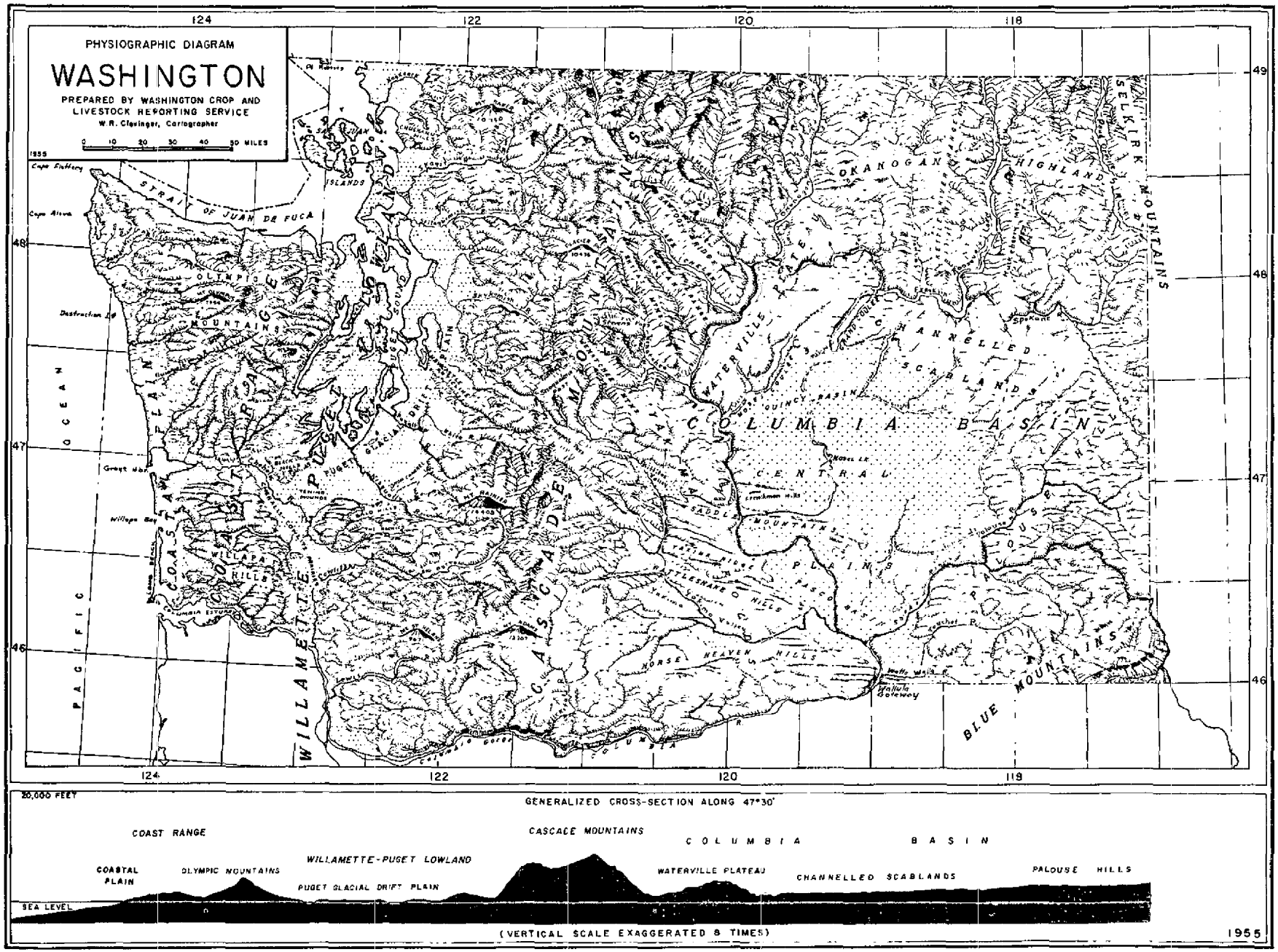
The Blue Mountains are an uplifted and eroded plateau extending into the southeastern corner of Washington. The strata are mainly ancient crystalline rocks which contain some minerals. The highest point of the mountains in the Washington section is Diamond Peak (6,401 feet), on the divide between the Grande Ronde, Tucannon and Touchet Rivers. These rivers, and the Walla Walla River, have cut valleys into the plateau. Extensive pine forest and grassland areas are in the highlands within Umatilla National Forest, where rainfall is 30 to 40 inches. The Snake River has cut a deep valley and gorge across the lower parts of the mountains. The area is well developed agriculturally around its northern foothills where wind-blown soils are deep and irrigation systems are used. The Walla Walla and Tucannon Valleys are rich grain, legume and livestock areas grown under irrigation and by dry farming. Grazing is an important use of the high lands by livestock ranchers in the upper valleys.

Topography of Douglas County

Douglas County has three primary topographic features and farming is carried out on a range of elevations of 700 feet along the Columbia River to 2,650 feet on the Waterville Plateau. Major topographic units are: (1) the Columbia River trough, (2) the Waterville Plateau and (3) the Channelled Scablands.

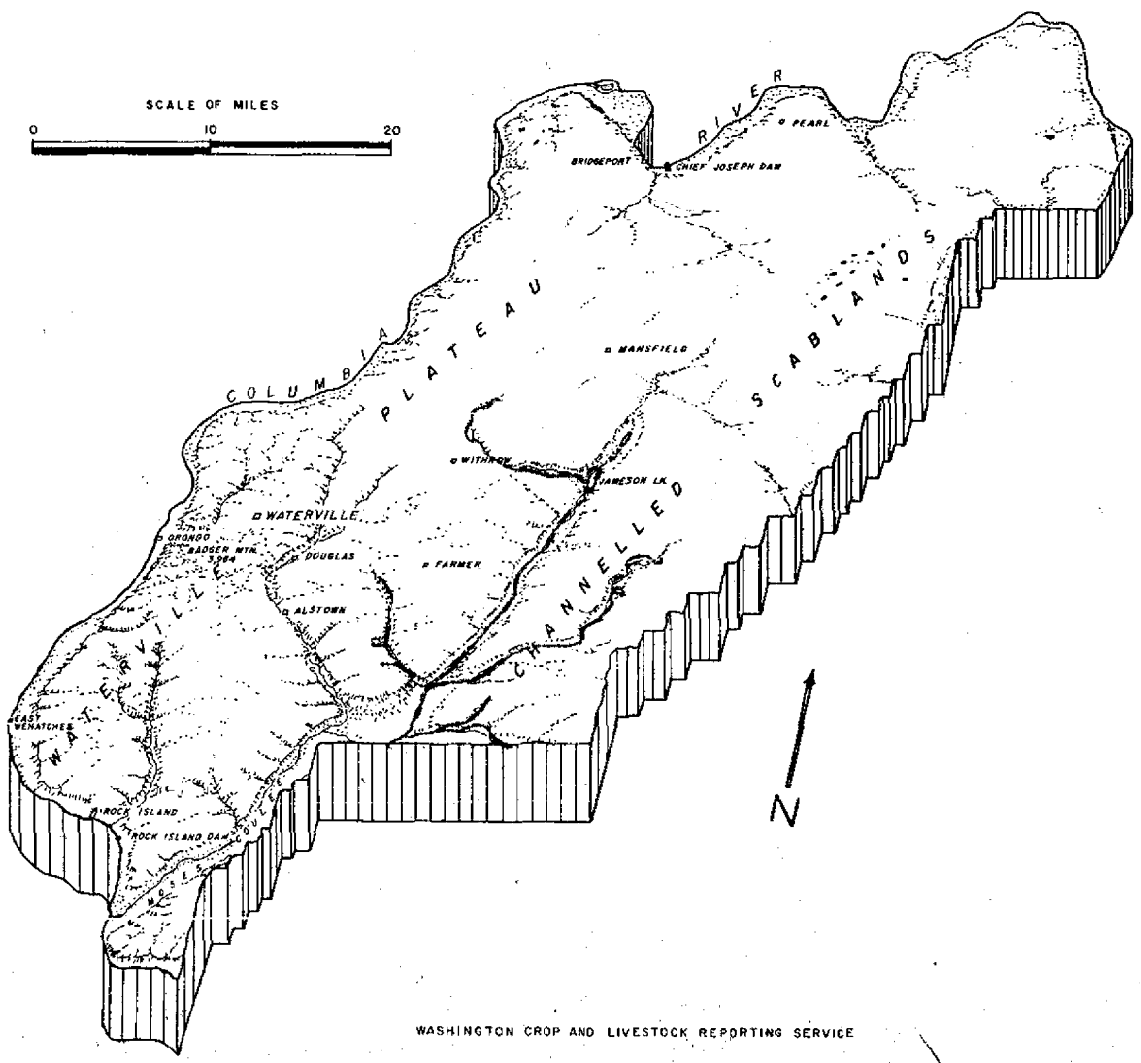
Through centuries of erosion, the Columbia River has entrenched itself deeply in a trough-shaped gorge through the Waterville Plateau. From Rock Island to Bridgeport and Chief Joseph Dam, the Columbia River flows at about 600 to 900 feet above sea level. On the Douglas County banks of the Columbia, there are a series of low benchlands and bars above flood level. These lowlands at East Wenatchee, Orondo, Beebe and Bridgeport are irrigated and are occupied mainly by orchards. The Badger Mountain ridge rises abruptly above the river benches to form the western edge of the Waterville Plateau, a table land of basaltic rock. Badger Mountain ridge reaches an elevation of 3,694 feet.

The Waterville Plateau slopes eastward from the Badger Mountain ridge and is one of the highest farming regions in the state. Elevations range from 2,200 to 2,700 feet. The plateau surface is a rolling plain of thin soils. Wind erosion has shaped its surface in many places, accumulating deposits of fine wind laid soils surrounding Mansfield, Waterville and Leahy. The bed rock of basalt is bare in some places and in the north part of the plateau large wind-scoured rocks looking like haystacks dot the tableland. Ancient glacial activity and older channels of the Columbia River have shaped the surface of the Plateau. Moses Coulee, a gorge-like valley, once the channel of the Columbia River, cuts across the tableland. The floor of Moses Coulee is occupied by ranches.


PHYSIOGRAPHIC DIAGRAM
WASHINGTON
PREPARED BY WASHINGTON CROP AND LIVESTOCK REPORTING SERVICE
W.R. Clevinger, Cartographer
0 10 20 30 40 50 MILES
1955
124
122
120
118
49
48
47
46
PACIFIC OCEAN
STRAIT OF JUAN DE FUCA
SAN JUAN ISLANDS
OLYMPIC MOUNTAINS
COASTAL PLAIN
PUGET GLACIAL DRIFT PLAIN
PUGET SOUND
WILLAMETTE-PUGET LOWLAND
COAST RANGE
CASCADE MOUNTAINS
OKANOGAN HIGHLAND
SELKIRK MOUNTAINS
COLUMBIA BASIN
WATERVILLE PLATEAU
CHANNELLED SCABLANDS
PALOUSE HILLS
CENTRAL PLAINS
SADDLE MOUNTAINS
HORSE HEAVEN HILLS
BLUE MOUNTAINS
COLUMBIA
GENERALIZED CROSS-SECTION ALONG 47°30'
20,000 FEET
SEA LEVEL
(VERTICAL SCALE EXAGGERATED 8 TIMES)
1955

TOPOGRAPHIC DIAGRAM

DOUGLAS COUNTY



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The Channelled Scablands make up eastern Douglas County. This area is featured by the channels of upper Moses Coulee, the precipitous gorge of the Grand Coulee and the gorge of the Columbia River below Grand Coulee Dam. Ancient glacial erosion followed by wind and flash rain storms have shaped minor features of the Scablands. The area is mainly nonfarm land, too dry or too stony for agriculture. Grand Coulee has been developed into a major reservoir impounding irrigation water pumped from Grand Coulee Dam.

Climate

Douglas County has a continental semi-arid type of climate with hot, dry summers and cold, humid winters. Climate at various points varies because of changes in elevation. The entire area lies in the extensive arid belt found in the lee of the Cascade Range of east-central Washington. Farming methods used today are adapted to 12 inches or less of precipitation per year. Irrigation in the valley and coulee floors and summer fallow methods of dryland grain growing on the plateau are necessary for successful crop growing.

Soil moisture received in the form of rain and snow is the major controlling natural factor in Douglas County agriculture. With the exception of the mountainous areas, precipitation is uniform over the county, ranging from about 8 to 12 inches per year. The Waterville Plateau is the driest belt with an average of 8 to 11 inches. Slightly more humid belts extend through the Badger Mountains and the uplands above the Grand Coulee. Winter months are the most humid, and snow is the principal type of precipitation. Snowfall is fairly reliable and provides protective cover against winter-kill of fall-sown wheat. Summers are relatively dry with occasional thunderstorm showers. Hail storms occur occasionally in the early summer and autumn.

The light fall rainfall and melt of snowfall is conserved in the soil by summer-fallow plowing. By use of the summer-fallow system of dry farming, sufficient top soil moisture is accumulated for crops of winter wheat and barley. Summer-fallowing prevents rapid evaporation during summer months. Evaporation in mid-winter is at a low rate, therefore, the moisture received is effectively absorbed in the porous Ritzville silt loams in the wheat growing belt on the Waterville Plateau.

Winter wheat growing is a highly successful practice adapted to the precipitation pattern. The grain is sown in the early fall in order for the plants to use the scant supply of top soil moisture received from fall and winter rainfall and snowmelt.

Temperatures in Douglas County are cold in the winter and warm in the summer. Averages vary with the altitude and terrain. Warmest areas with the longest growing seasons are in the lower benchlands and bars bordering the Columbia River. Orchard areas surrounding East Wenatchee, Orondo and Bridgeport are warmed in the autumn, winter and spring seasons by air descending from the Cascades and the Plateau. When air descends into the Columbia River gorge it is warmed by being compressed into a smaller volume while flowing to a lower altitude. Because a cubic foot of air will be warmed about 5 degrees by compression for each thousand feet of descent, the low districts in the gorge are often 10 or more degrees warmer than the higher districts in the Cascades across the Columbia River or on the adjacent Waterville Plateau. The air drainage into the lowlands often comes as warm Chinook breezes. This air

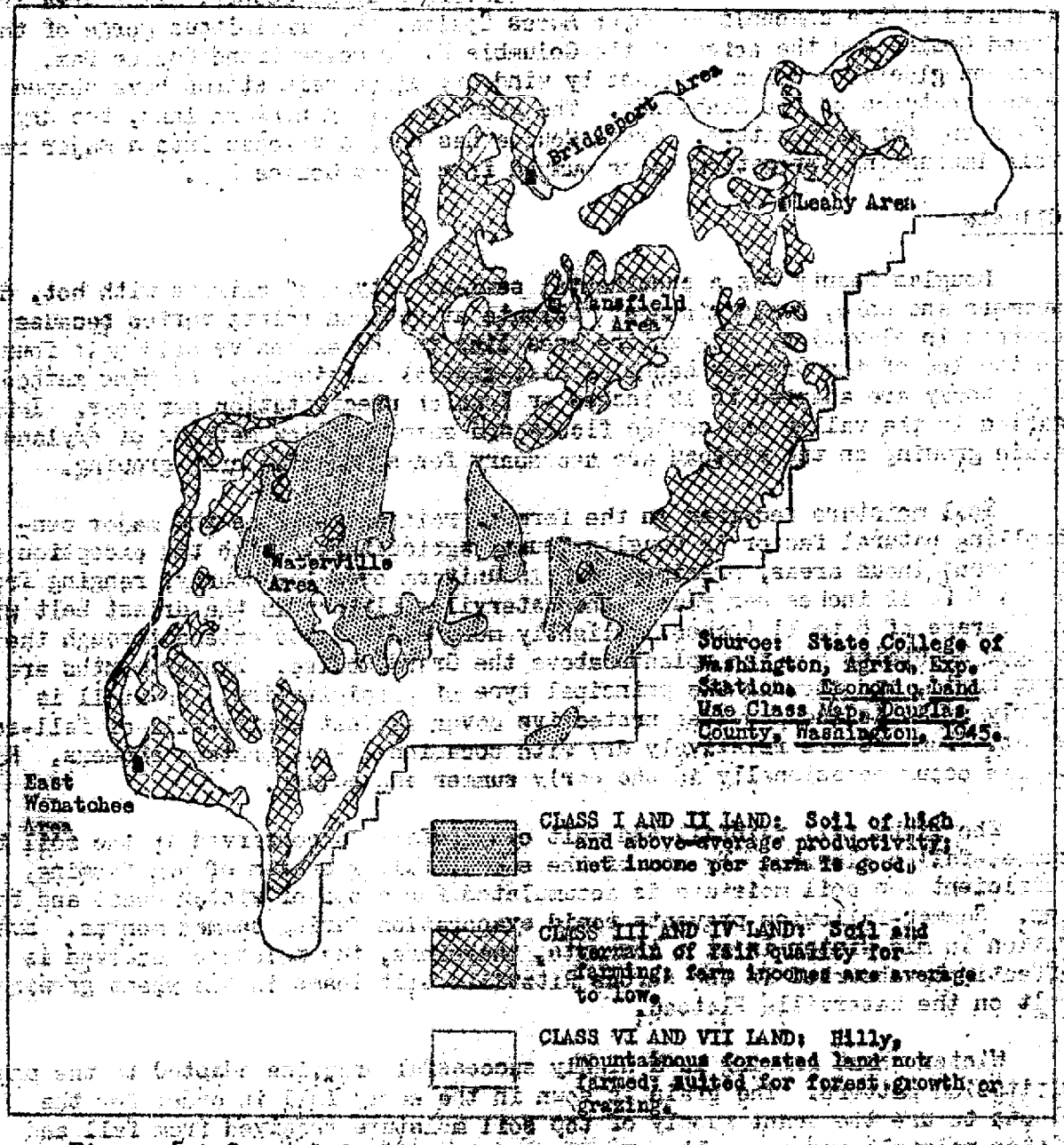

Figure 5.- General Quality of Land For Farming in Douglas County

Table 6.- Precipitation for Selected Stations by Months
Douglas County

Station and Elevation in Feet	Average Monthly Precipitation in Inches												Annual Total (Inches)
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Chief Joseph Dam (821)	1.16	.29	.90	.71	1.28	2.29	T	1.48	.68	T	1.38	.59	10.05
Mansfield (2,267)	1.28	1.04	.65	.66	.61	1.17	.30	.39	.39	.70	1.21	1.46	9.82
Waterville (2,605)	1.48	1.19	.79	.70	.91	.87	.39	.40	.56	.74	1.45	1.75	11.23

Source: U.S. Weather Bureau, Annual Summary, Washington State, 1956.

drainage also protects the fruit orchards from extremely cold temperatures or killing frosts during the budding and blooming season. Bridgeport and East Wenatchee have midwinter daily temperature averages of about 25 degrees; in the midsummer period the average is 70 to 75.

The higher wheat growing region on the Waterville Plateau is considerably cooler than the Columbia River lowlands. Being nearly 2,000 feet higher, the plateau districts surrounding Waterville and Mansfield have midwinter daily temperature averages of about 20 degrees. In the summer, the days are hot and the nights cool. The daily average at Waterville in August is about 66 degrees. Waterville has had an extremely cold temperature of -30 degrees recorded by the Weather Bureau. The warmest temperature extreme recorded is a reading of 110 degrees at Rock Island.

Altitude and air circulation causes a variety of growing seasons and average times for killing frosts. Columbia River lowland orchard areas generally have a growing season of 175 to 200 days. Here, the first killing frost generally comes in mid-October and the last near the end of April. The higher plateau tablelands around Waterville and Mansfield generally have growing seasons of 150 to as low as 125 days per year. Frosts come as early, on the average, as the last of September and as late in the crop season as mid-May. Temperature conditions on the plateau are risky for frost-sensitive crops, and the hardy varieties of wheat, barley and oats are more adaptable. Winterkill of grain sprouts is also a risk when snow cover is below average.

Table 7.- Temperatures For Selected Stations, By Months
Douglas County and Bordering Stations

Station and Elevation in Feet	Average Temperatures (in degrees Fahrenheit)												Annual Average
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
Chief Joseph Dam (821)	24.4	36.2	39.2	48.9	59.7	62.3	68.7	--	61.3	47.4	42.7	29.4	NA 1/
Waterville (2,605)	21.1	26.2	35.8	45.7	53.1	59.9	67.2	66.5	57.4	47.0	33.4	25.0	44.9
Wenatchee (634)	25.8	30.8	43.0	52.3	59.4	66.1	73.4	71.6	62.4	51.0	37.8	29.6	50.3

1/ NA - not available for a long term record.

Source: U.S. Weather Bureau, Climatological Data, Washington, Annual Summary, 1956

Table 8.- Temperature Extremes, Dates of Killing Frost
Douglas County

Station	Temperature Extremes Recorded (degrees Fahrenheit)		Killing Frost Average Dates	
	Coldest	Hottest	Last in Spring	First in Fall
Brewster	110	-23	April 17	October 12
Rock Island	110	-26	April 22	October 16
Waterville	104	-30	May 16	September 29

Source: U.S. Weather Bureau